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Title	Forest Fire that Occurred in Kuji City of Iwate Prefecture
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Citation	北海道大學農學部 演習林研究報告, 42(3), 547-558
Issue Date	1985-09
Doc URL	https://hdl.handle.net/2115/21142
Type	departmental bulletin paper
File Information	42(3)_P547-558.pdf



Forest Fire that Occurred in Kuji City of Iwate Prefecture*

By

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岩手県久慈市で発生した森林火災*

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1. Preface

On the 27th of April in 1983, there occurred many forest fires in northern part of Honshu in Japan. (Fig. 1). One of them is that occurred in Kuji City

* Received February 28, 1985.

* A part of this paper was presented at the Annual Meeting of the Japanese Forestry Society, Tokyo, April 1984.

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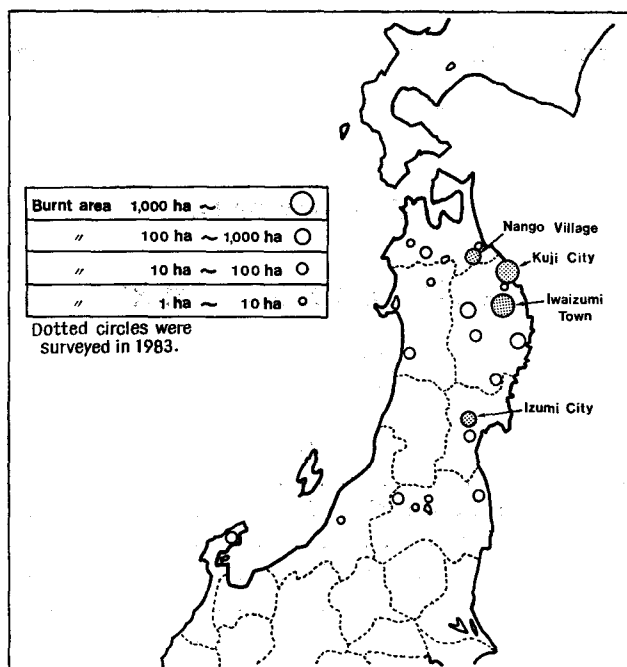


Fig. 1. Forest fires occurred on April 27, 1983⁴⁾.

of Iwate Prefecture. Under extraordinary climate conditions such as low humidity and strong wind, an unhappy fire spread slowly and flew to the other eastern point, then spread rapidly. Many houses were burnt by this big fire. Such fire will happen in near future, as in Australia and USA¹⁾ and valuable forests and human lives may be thrown into a terrible crucible. General outline^{2~7)} will be introduced, the problems and some proposals will be described.

I have to express sincere thanks for Mr Mifune S., the section chief of Fire Defense at Kuji Fire Station, who explained and guided me around the damaged area, and also for the kind officers in Iwate Prefecture and Japan Forestry Agency, Dr. SWANSON F. in Pacific Northwest Forest and Range Experiment Station of USDA and Dr. YAMAGISHI K. in Hokkaido Forest Products Research Institute who gave me valuable literatures.

2. Occurrence and suppression of the fire

2.1. Conditions of climate

Data observed by Kuji Fire Station at 12 o'clock on April 27 are as follows :

Climate	fine
Wind direction	North West
Wind speed	
Average	5.2 m/sec
Maximum	10.0 m/sec
Temperature	24.5°C

Relative humidity	17.0%
Days from last rainy day	8 days
Fire warning	yet
Precipitation of last 10 days	2.5 mm

The maximum instantaneous wind speed at 15 o'clock was 28.8 m/sec, and it on a patrol ship staying on Kuji bay was 38 m/sec.

At the district of side of the Pacific Ocean, so-called "Föhn phenomenon" occurred by strong wind coming over the Ohu mountain range. Dried and strong wind of high temperature blew wildly, and it became a dangerous climate for fire.

2.2. Circumstances of the fire that occurred

Kuji City is located in the northern part of Rikuchu Sea Coast National Park, and the population is 40 thousands people, the area is 330 km², the forest occupies 270 km² which is about 82% of the total area of Kuji City.

The fire occurred point is at about 2 km of SSE from Kuji Fire Station. The south of the point is ranged mountains, the east and north are residential quarters and west is rice field.

The fire occurred forest is a private forest of altitude 50~70 m, and is a natural forest of red pine. A forest named Hirasawa district, which was burnt by a flown fire from the fire occurred point (Kamiosanai district) is also a private forest of altitude 150 to 200 m, and is composed of conifer tree 40%, broad-leaved tree 60%. And the eastern part of it faces to the Pacific Ocean. Then, on the coast several hamlets, named Tamanowaki, Futago, Funawatari, Ohjiri and Kosode, dot.

Water supply system is composed of 20 fire suppression hydrants (Tube diameter -75 mm), 8 water basins (40 m³-4, below 20 m³-4), 2 rivers and 1 sea water.

2.3. Activities of fire suppression

2.3.1. Outline of the fire (Fig. 2)

1) Fire occurred point is in a forest of the altitude 45 m. It is estimated near the top of a mountain road. Dry grasses, Sasa on the ground and natural pines burnt to the south direction. Ten hectares burnt for 3 hours. Strong sudden wind (North-Western one, maximum 28.8 m) blew, and fire particles flew for 600 m.

2) The flown fire particules ignited dry grasses at the mountain foot of Hirasawa forest. The strong wind fanned the fire to north eastern direction through pine forest. The fire as the ground surface fire and crown fire spread rapidly to two directions of Tamanowaki and Funawatari.

3) At about 1640, several buildings and houses were ignited by the flown fire particles, and spread rapidly. After 10 minutes, the buildings and houses in the district of Futago and Ohjiri were ignited and the fire spread. The houses at the both side of Prefecture-road at Tamanowaki district burnt and fell down, so the road became unavialable for passing through.

4) Next day, on the 28th, Japanese army and several helicopters began to work with the fire troops, then the fire was suppressed in the afternoon of 29th.

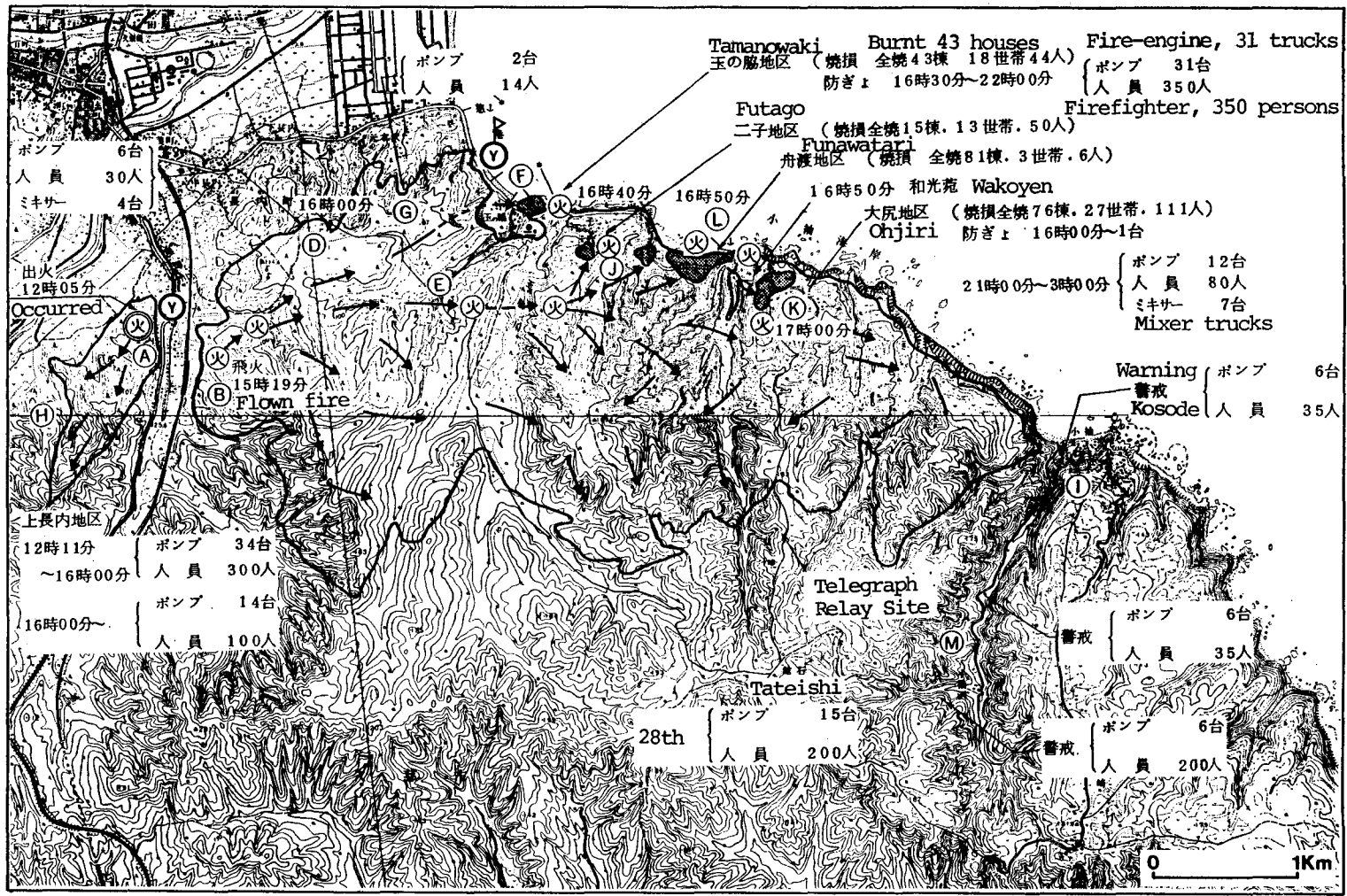


Fig. 2. Performance of forest fire that occurred in Kuji City and the activities for the fire suppression.⁴⁾

2.3.2. Information and early fire suppression

Mr. F, the first informer, went to a car repairer located at Kamiosanai, and at noon he found a fire and smoke on the western hill. He called a fire station by phone-number 119, at 8 minutes past 12 o'clock. Early fire suppression was not tried.

2.3.3 Progress of fire suppression

1) April 27

- 1208 Found the fire (Telephone call by No. 119 information)
 - 1209 Turnout (Two of fire engines bearing water tank, 15 firemen)
 - 1211 Arrived at the fire point. Fire was spreading on top of the hill.
 - 1212 Order of first turnout for City fire party (1st, 3rd, 11th subparties)
 - 1215 Order of second turnout for City fire party (2nd, 4th, 5th, 9th, 12th subparties)
 - 1215 Order of second turnout for City fire party (2nd, 4th, 5th, 9th, 12th subparties)
 - 1230 Burnt area is 3 ha, and the fire is spreading to the south direction.
 - 1230 Order of third turnout for City fire party (6th, 7th, 8th, 10th subparties). This means the order for all firemen in Kuji City.
 - 1500 Burnt area is 10 ha.
 - 1505 Asked the assistance for nearby towns and villages.
 - 1519 Fire particles flew across the national-road No. 45, and ignited Hirasawa forest. North western wind blew with an instantaneous speed 28.8 m/s, and the temperature was 22°C.
 - 1529 Another forest fire happened at Nagasaka of Ube town, which is located at the southern part of Kuji City. Three fire engines, 9 small fire engines and 160 firemen went there, and suppressed it with 4 hours. Burnt area was 4 ha. It may have been caused by the abandon of cigarette.
 - 1550 Asked army to send members and helicopters to suppress the fire.
 - 1600 Order of movement from Kamiosanai to Tamanowaki.
 - 1635 Order of escape from the district of Tamanowaki, Futago and Ohjiri.
 - 1720 Futago district is burning
 - 1814 Asked the assistance for Maritime Safety Agency at Hachinoye. Four patrol ships appeared.
 - 1823 Marine rescue activity was begun. Rescue boat of the Maritime Safety Agency and a working ship of Miyagi Construction Company worked at Tamanowaki and Funawatari districts, where 28 people were saved.
 - 1905 Fire is spreading at Ohjiri and near Wakohyen (an old people's home).
 - 2230 Fifty soldiers arrived from Hachinoye post, and went to Kosode district.
- #### 2) April 28
- 430 Reconnoitering flight by a helicopter from Maritime Safety Agency.
 - 600 Fire suppression activity by helicopters was begun, until 1800.

- 600 Fire prevention line was established in the Kamiosanai forest.
 723 Fire is spreading to Tateishi district.
 900 At Tateishi district and near Relay Site of Telegraph and Telephone Public Corporation, jet shooter parties began to work. Thirty people from a local forestry office, 50 people from Noda Fire Party, 130 soldiers worked for the suppression.
 920 Seven mixer trucks (6 ton) went to Tateishi to carry water. Until 1800, every fire parties have worked hard at every spreading line.
- 3) April 29
 500 Reconnoitering flight (a little rainy).
 720 Four fire engines departed.
 800 Every fire parties departed to Telegraph and Telephone Relay Site at Ohjiri, Hirasawa and Kamiosanai districts.
 1010 Helicopters began to work until 12 o'clock. (two big ones and two middle ones)
 1030 General suppression of the fire force.
 1530 Complete suppression of the fire.

2.3.4. Composition of fire defense parties

Number of fire engines, the other cars and persons worked during this fire are shown in Table 1.

Seventy seven fire engines, 145 the other cars, 12 helicopters and 1720 people at the maximum value worked hard. And the total number for three days are 198 fire engines, 347 the other cars, 18 helicopters and 4907 people, they fought this severe fire.

2.3.5. Aerial fire suppression

Aerial fire suppression by helicopters were as follows :

- 1) April 28
 600 Two middle helicopters (HU-1) from air force in Sendai began to work for the fire suppression.
 1000 Two big helicopters (V-107) from air force in Kisarazu and two middle ones (HU-1) from air force in Sendai arrived carrying the various materials.
 1300 Four big helicopters (V-107) from air force in Kisarazu arrived.
 Until 1800, six big helicopters and 4 middle ones worked 206 times in total for the fire suppression and carrying the materials including MAP from Miyako.
- 2) April 29
 From 10 to 12 o'clock, two big helicopters and two middle ones worked 4 times for the fire suppression.
- 3) Instruments used for the fire suppression is shown in Table 2.
 4) Fire retardants.
 Monoammonium phosphate (MAP) was 4200 kg, and viscosity increaser (Sunrose EX-1, CMC) was 200 kg. Total amount (Chemicals & Water) was 183 ton.

Table 1. Composition of fire defense parties²⁾

Organizations	27th			28th			29th		
	Fire engine	The other car	Person	Fire engine	The other car	Person	Fire engine	The other car	Person
Fire headquarter and station	4	4	40	4	4	53	4	4	36
Kuji city fire party	42	1	546	42	1	549	42	1	330
Taneichi town fire party	10	1	90	8	1	85			
Oono village fire defense party	7	1	63	6	1	54			
Yamagata village fire defense party	3	2	45	7	1	75			
Noda village fire defense party	5	2	81	5	2	99			
Fudai village fire defense party	4	1	41	5	1	55			
subtotal	75	12	906	77	11	970	46	5	366
Army		29	325		41	366		106	931
Air force, Helicopters, Reconnoiter					(2)			(2)	
Middle					(4)	48		(2)	30
Big					(6)			(2)	
Iwate Prefecture Police		21	69		26	92		20	65
Kuji Police Sitation		8	56		8	56		8	56
Local Forestry Office			13			43			
Cooperators			177			118			168
The others (Mixer trucks)		19	19		27	27		6	6
Total	75	89	1565	77	113	1720	46	145	1622
(Total of helicopters)					(12)			(6)	

Table 2. Materials used for aerial fire suppression²⁾

Materials	April 28	April 29
Fire engine	3	1
Small fire engine	7	3
Water tank (2500 liter)	3	2
Water bag (1800 liter)	3	2
Water bag (700 liter)	4	2
Mixer	2	2

5) Heliports

For the loading of fire retardants, a dry riverbed of Kuji River left coast in front of Kuji elementary school was used. For the supply of fuel, Kuji City baseball ground was used.

2.4. General damages

2.4.1. Damaged area

Forest and field was 1,085 ha ; forest was 1035 ha in it.

Buildings 17,371 m²

Living houses...completely burnt houses were 45, and the total area was 7,097 m².

Unliving houses...completely burnt houses were 179, and the total area was 10,279 m². Partly burnt houses were 3.

2.4.2. Damaged amount of money

Total	1,274 million yen
Forest	733 "
Buildings	520 "
Ships (Fish boats 120)	10 "
Cars (3)	1 "
The others	10 "

2.4.3. Suffered people

The suffered households were 61, and the people were 211. Fortunately there were no dead people, only 2 people got a little hurt. This means the early escape from the dangerous zone.

2.5. Damages for forest

The Forestry Agency asked the Japan Forest Technical Association to survey this area and published a fine report.⁹⁾

Burnt area was almost forest (96%), however, housing land was included by 8 ha. (Table 3). As for the forest composition, main species were *Quercus serrata* and *Q. acutissima* (63%), *Pinus densiflora* (23%) as shown in Table 4. Tree height was mainly 6~10 m (71%) and 0~5 m (23%) as shown in Table 5. Crown density was fairly big showing 71% as shown in Table 6.

Degree and area of damaged forest is shown in Table 7. Standard of classifi-

Table 3. Utilization of the area burnt⁵⁾

Conditions of the land	(ha)	(%)
Forest	929	96
Housing land	8	1
Cultivated land	22	2
Grassland	2	—
The others	3	1
Total	964	100
Driveway		
exists	71	7
no	893	93
Footway		
exists	566	59
no	398	41

Table 4. Forest composition⁵⁾

Tree species	(ha)	(%)
<i>Quercus serrata</i> & <i>Q. acutissima</i>	613	63
<i>Pinus densiflora</i>	225	23
<i>Cryptomeria japonica</i>	36	4
<i>Larix leptolepis</i>	6	1
Young trees planted	32	4
Cut area	17	2
Out of forest	35	4
Total	964	100

Table 5. Tree height⁵⁾

Height	(ha)	(%)
Out of forest	35	4
0~5 m	222	23
6~10 m	685	71
11 m or more	22	2
Total	964	100

Table 6. Crown density⁵⁾

Density	(ha)	(%)
Out of forest	35	4
0~40%	126	13
41~70%	114	12
71% or more	689	71
Total	964	100

Table 7. Degree and area of damaged forest⁵⁾

	Degree of damage			Total
	Severe	Medium	Light	
Ground cover, burnt	severely	severely	slightly	
Stem, burnt	all	much	at base	
Crown, burnt	all	partly	partly	
Area (ha)	366	387	211	964
Percent (%)	38	40	22	100

cation of the degree is also explained in Table 7. Severely burnt area was 38% and mediumly burnt area was 40%.

Severely damaged ratios in various tree species were as follows: Young trees planted 47%, Cut area 41%, *Pinus densiflora* 40%, *Quercus serrata* and *Q. acutissima* 38%, Out of forest 34%, *Larix leptolepis* 16%, *Cryptomeria japonica* 14%. The inclination about the fire resistance of various tree species was not clear according to the total consideration on Nango, Iwaizumi, Izumi and Kuji districts. Only young trees planted were damaged severely in every district.

The relation between tree height and severely damaged district ratio showed clear result, that is, the higher the tree is, the lower the damage becomes.

3. Investigation of this fire

“Fire Defense Investigation Meeting”⁹⁾ were promoted by Iwate Prefecture on July 3~4, and by Kuji City on July 14. The main results are as follows:

3.1. Management of forest

Improvement cutting and thinnings were so unsatisfactory that the combustible matters covered the ground surface. This caused the fire spreading. It is needed that the establishment of “Fire Defense Zone” and strong practice of improvement cutting and thinnings.

3.2 Prevention and public information

It is very difficult to inform the fire preventive attention or warning to unspecified many persons who enter into forest to harvest edible wild plants and fungi. But, it is needed to utilize a standing information board, a banner strung across a way, an information from sky by aircraft. And an extensive enlightenment of the thoughts of forest protection and fire defense is also important.

3.3 Water supply

Fire suppressive activity bases mainly on the extinguishment by water. The insufficient water supply caused the fire spreading. So, the complete preparation and repletion of water pond, seizing the water convenience to utilize natural water, and the construction of road to river or valley are important problems. Mixer trucks worked very effectively to carry much water into the forest.

4. Conclusion

Föhn phenomenon will be caught from the climate conditions. Loudy public information and the intensified patrol by many fire-engines and helicopters are necessary.

Scientific fire suppression should be adopted rapidly. Fairly many big helicopters should be bought by Japan Fire Defense Agency and also Fire Defense Division of every Prefecture. The budget may be issued from Japan Monopoly Corporation, because cigarette causes many fires.

New houses and buildings should be fire-proof but the fine wooden panels as the interior materials will give us comfortable feelings.

Improvement cutting and thinnings should be practiced by voluntary groups. Harvested logs may be utilized as the wooden crafts or biomass energy. As the results, the forest will become healthy and the forestry will become hopeful.

Summary

On April 27 in 1983, so-called “Föhn phenomenon” caused many forest fires in northern part of Japan. One of them happened in a forest of Kuji City, the damaged area was 1000 ha composed of *Quercus serrata*, *Quercus acutissima* and

Pinus densiflora. The fire also attacked several hamlets spotted in coast of the Pacific Ocean. Completely burnt houses were 224 ones and the damaged properties amounted to 1300 million yen.

This paper describes the outline of the fire and the problems, and several thoughts are proposed as follows:

1) Prevention activities.

Föhn phenomenon will be preknown from the performance of the climate. From which, public information and the patrol should be intensified for the fire prevention.

2) Scientific fire suppression.

Aerial operation shows splendid effects on the fire suppression.^{8~10} Fairly many helicopters should be increased at Fire Defense Agency and should be put at Fire Defense Division of every Prefecture. The funds may be issued from the profit of Japan Monopoly Corporation, because the cigarette has been causing many fires.⁹

3) Fire-proofing or fire-retardation of houses.

New houses and buildings should be fire-proof or fire-retard. However, the windows are so weak⁷ for flame that the fire-proof shutters outside of the windows should be adopted.

4) Improvement of forestry.

Forest driveway, fire defense zone and water pond should be prepared or the maintenance should be noticed. Improvement cutting or thinnings should be practiced by voluntary cooperation of nearby people including silver-aged voluntary group under the guidance of Forest owners' association. Harvested logs may be utilized as wooden craft or biomass energy.

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要 約

1983年4月27日、いわゆるフェーン現象により、東北地方を中心として多数の森林火災が発生した。なかでも久慈市の山林に、タバコを原因として発生した森林火災は、1,000 haのコナラ・クスギ・アカマツ林を焼いたうえ、海岸に点在する数集落を襲って建物224棟を全焼させ、損害額は13億円にのぼった。

本論文は、この火災の状況・問題点をあきらかにし、後記提案をして、今後役に立てようとするものである。

1. 予防活動の強化

気象状況によりフェーン現象の予知をおこない、広報・パトロールなどの火災予防措置に全力をあげる。

2. 科学消防の強化

空中消火の抜群の効果にかんがみ、消防庁あるいは各県消防担当部に、ヘリコプターの増強・設置をはかること。その財源としては、火災原因の多数を占めるのはタバコであるから、専売公社の収益金を計画的に充当することを考慮する。

3. 建物の不燃・難燃化

今後、建設される住宅・建物の外装の不燃・難燃化をすすめるよう配慮する。たとえ、それをすすめても、窓から火災が進入するから、防火シャッターの設置を考えること。しかし、内装材として木材の使用は、人間に好適なフィーリングを与えるであろう。

4. 林業の改善

林道・防火線・貯水槽の整備をおこない。除間伐も森林組合・シルバーエイジボランティアグループをふくめた付近住民の協力によりおこない、木材工芸品・バイオマスエネルギーなどとしての活用をすすめることが望ましい。結果として、森林も健康かつ優良となり林業としての展望も開けてくるであろう。